SUMMARY OF THE ADVANCED KE PENETRATOR FOR THE ALACV STO

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39th Gun &

Supporting Cast

Weapons and Materials Research

Tim Farrand & Lee Magness	***WMRD –Terminal Ballistics***
Robert Shnidman, John Abell	***SLAD - wit pack analysis/redu***
Jodi Roberston, Rob Gangler, Jim Strobel (ret), Aivars Ozolins (Oz)	***SLAD – LoF systematic analysi experimental LoF***
Experimental facility	***WMRD – target/wit pack set-u***
Shops	***WMRD – manufacture targets, sabot SLAD – witness packs assemble & re***

Overview of ALACV KE

- Initial Paper Study
  - Quantify STO requirement
  - Establish Experimental Methodology
- Iterative Progression of Penetrator Design
  - Terminal Ballistic evaluations
  - BAD Analysis
- Final Design
  - Monolithic
  - ENLE

STO Objectives - Exit Criteria Advanced KE

- Develop and demonstrate advanced KE penetrators using tungsten or other alternative materials
  - Exit Criteria:
    - Achieve a 30% increase in behind armor effects (BAE) over a baseline APFSDS penetrator.
    - Relate a 30% increase in the combined (BAE) to an increase in Probability of Kill (P_k) of 10% over the baseline.

Novel Penetrators

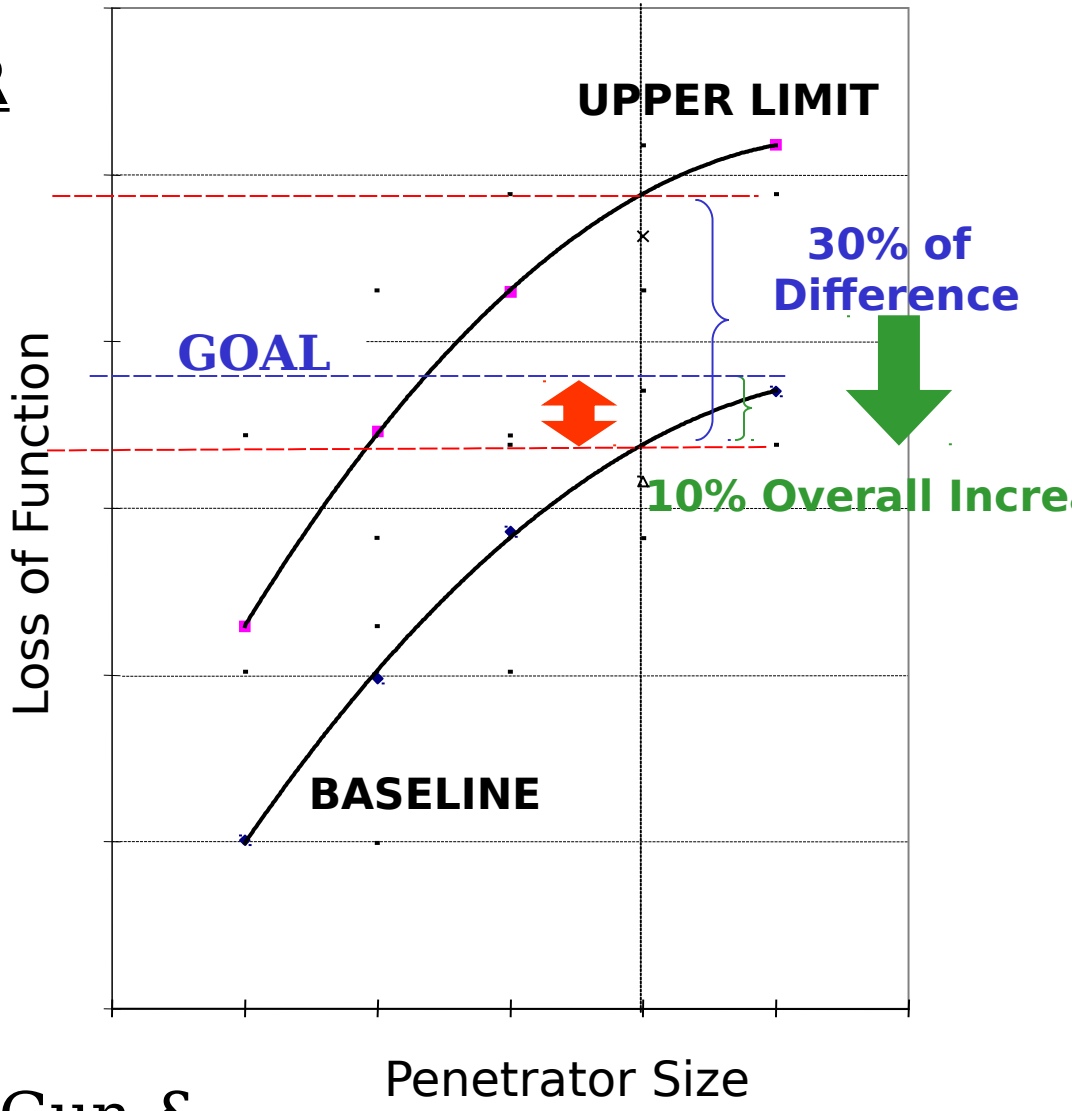
Quantified 30% BAE Increase

MF-KILL VS CALIBER

A SLAD Parametric Study of lightly armored vehicle

Goal: 30% increase in BAE

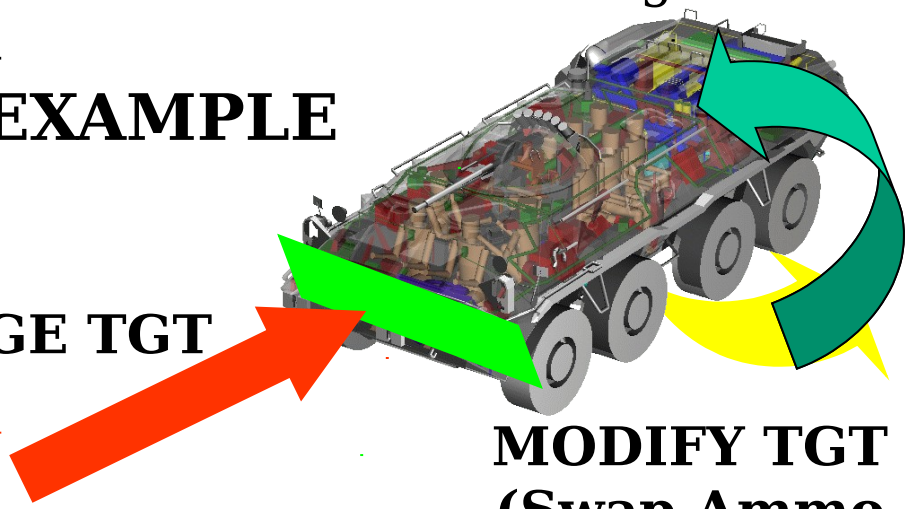
Measure: an approximate *10% increase* in Loss of Function for this system



Establish Experimental Methodology

Use one range target for down select of Penetrator Designs
- modified vehicle description

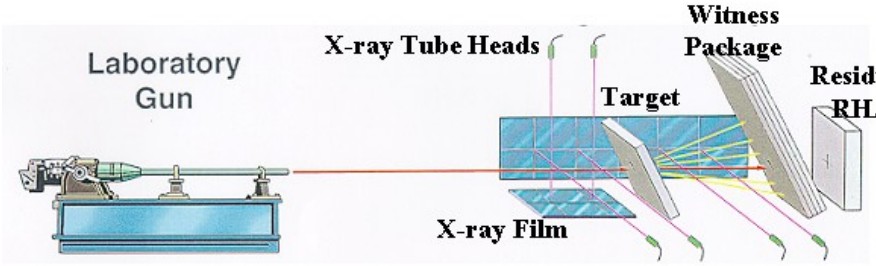
EXAMPLE

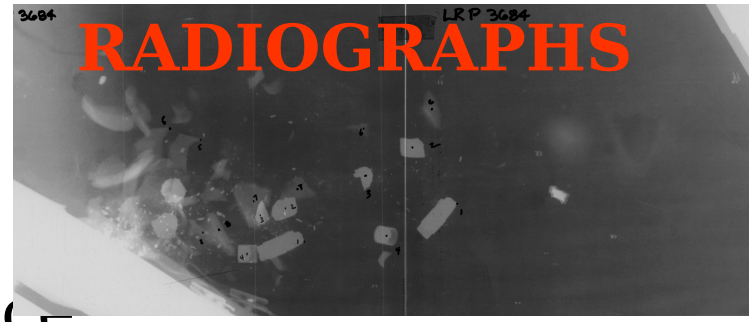


Final Target Model

- One Range Target (impact location)
- Modify Interior of Vehicle
- Produced Similar Results to a Cardioid Average
- **Good Representative Target**

Data Analysis



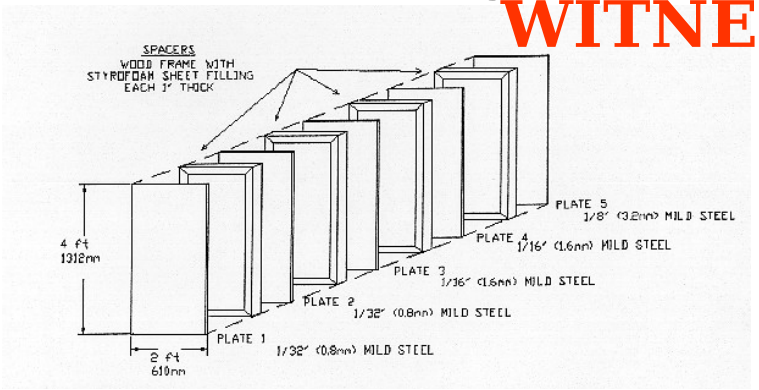


Examine Penetrator Performance

- Qualify penetrator failure mechanisms
- Estimate Defeat Range

Evaluate Behind Armor Effects

- Penetrator and Target


SPACERS
WOOD FRAME WITH STYROFOAM SHEET FILLING EACH 1" THICK
4 ft 1312mm
2 ft 610mm
PLATE 1 1/32" (0.8mm) MILD STEEL
PLATE 2 1/32" (0.8mm) MILD STEEL
PLATE 3 1/16" (1.6mm) MILD STEEL
PLATE 4 1/16" (1.6mm) MILD STEEL
PLATE 5 1/8" (3.2mm) MILD STEEL

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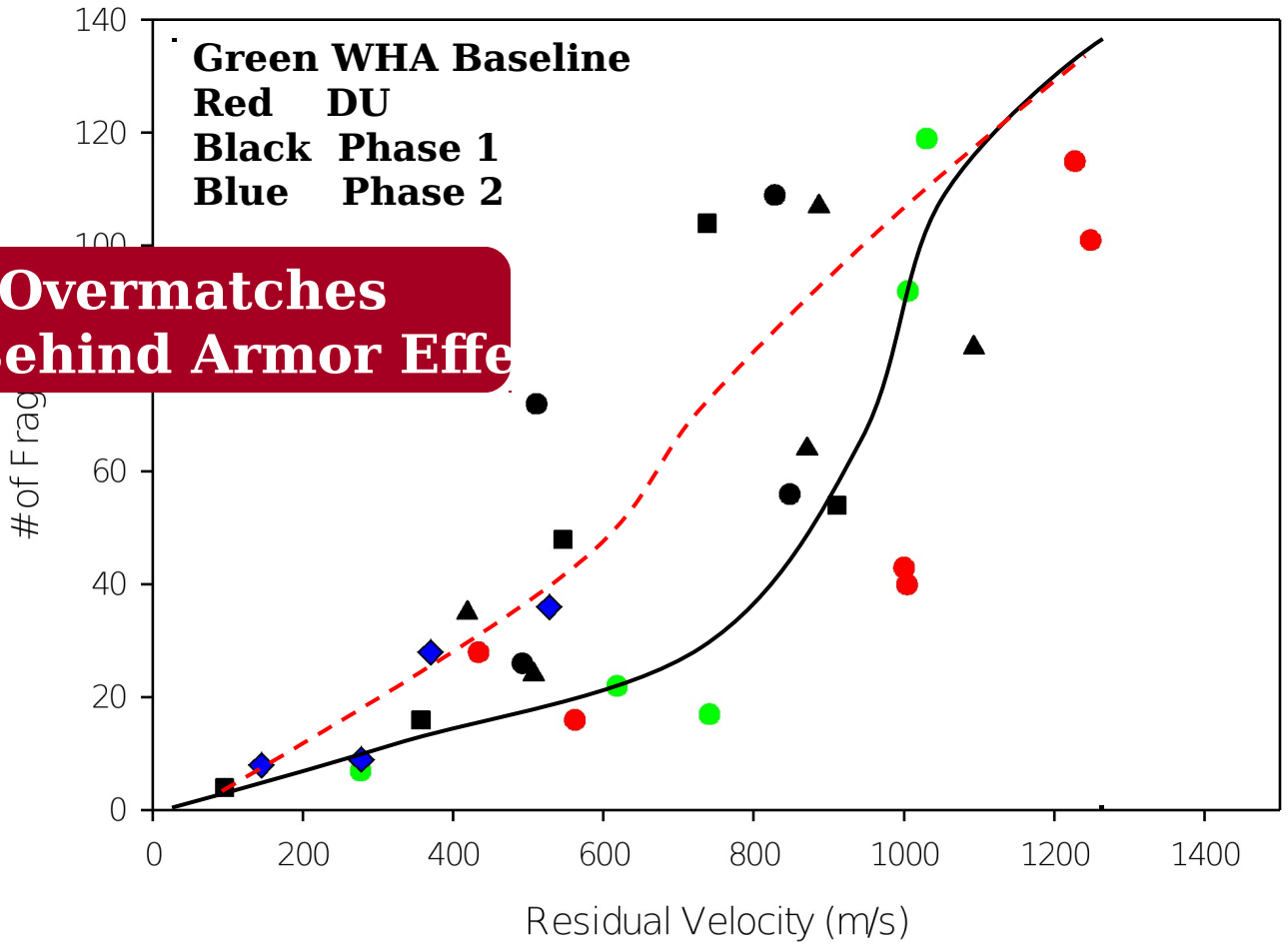
Design Iterations

	Design Iterations	# Sho
1	scaled design	11
2	alternate designs – ENLE	3
2a	*supplement w/ mission evaluations (Magness)*	*30*
3	ENLE designs	26
4	Material & Geometry mods	35
5	ENLE mods	10
6	ENLE mods (fins – dia)	15
7	Final design w/ baseline	71

Behind Armor Debris (Phase 1 & 2)

Weapons and Materials Research



Medium Overmatches
LE greater Behind Armor Effe

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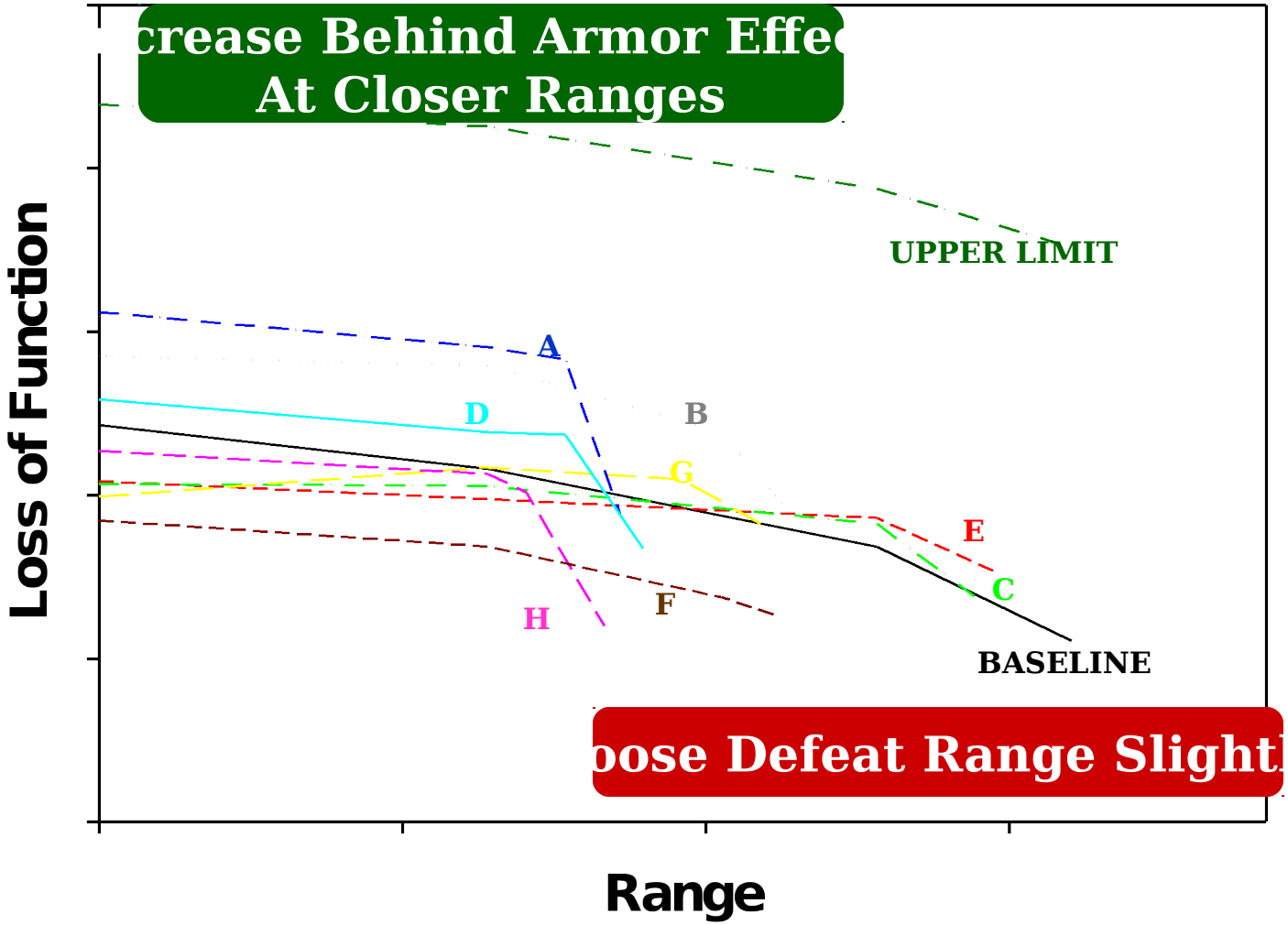
Loss of Function for Range Target (Phase 1 & 2)

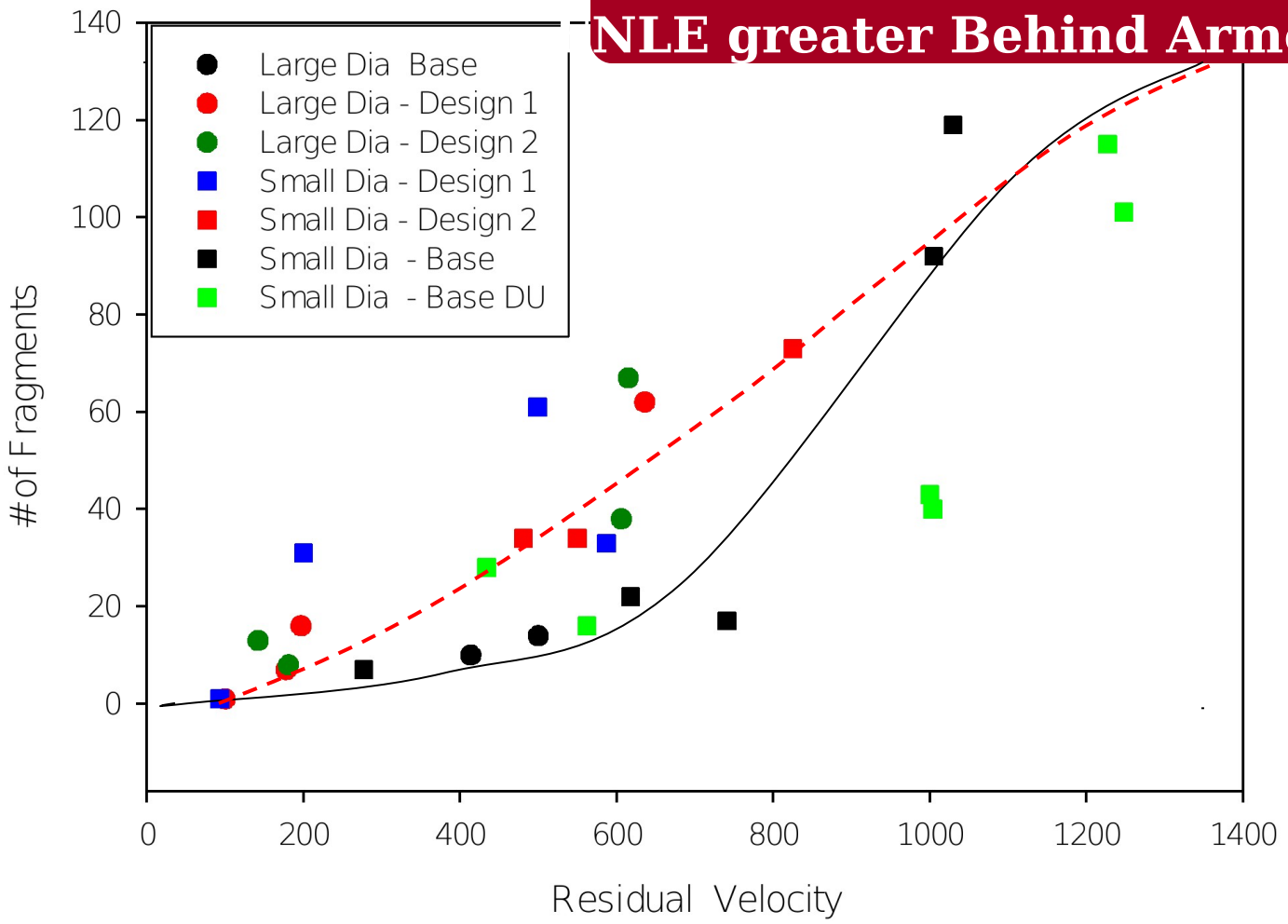
SURVIVABILITY/LETHALITY ANALYSIS DIRECTORATE



Behind Armor Debris (Phase 3)

Weapons and Materials Research

Medium Overmatches
NLE greater Behind Armor Effect



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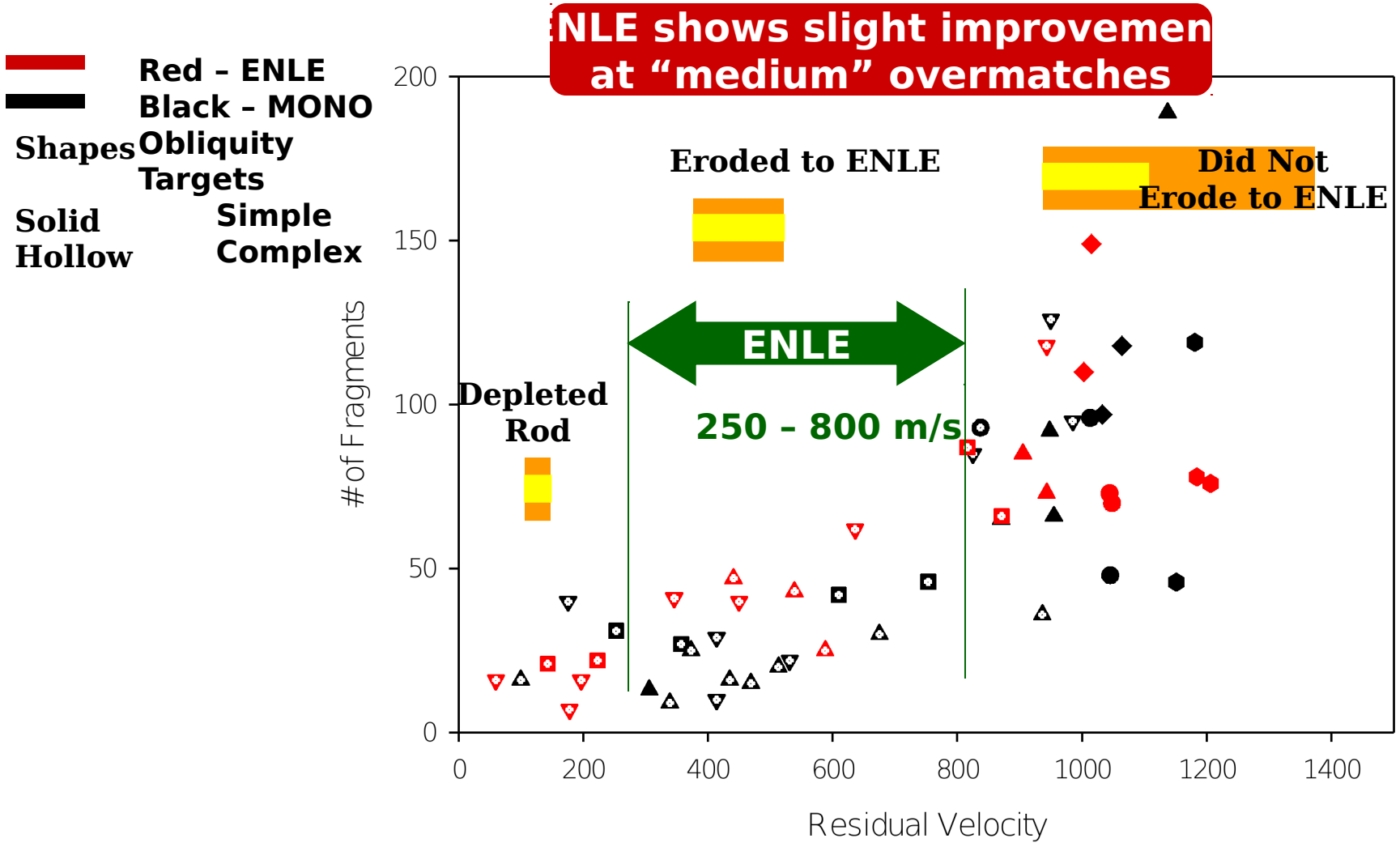
Modeling / Analysis
Final Design

1. Modify ***Perforation*** models for specific Mono & ENL
2. Develop ***BAD*** models for MONO & ENLE
3. Input ***Perforation*** and ***BAD*** models into Lethality Tar
4. Run Lethality Target Model for:
    1. All angles of attack
    2. Average for frontal 60^{o} arc & Cardioid average

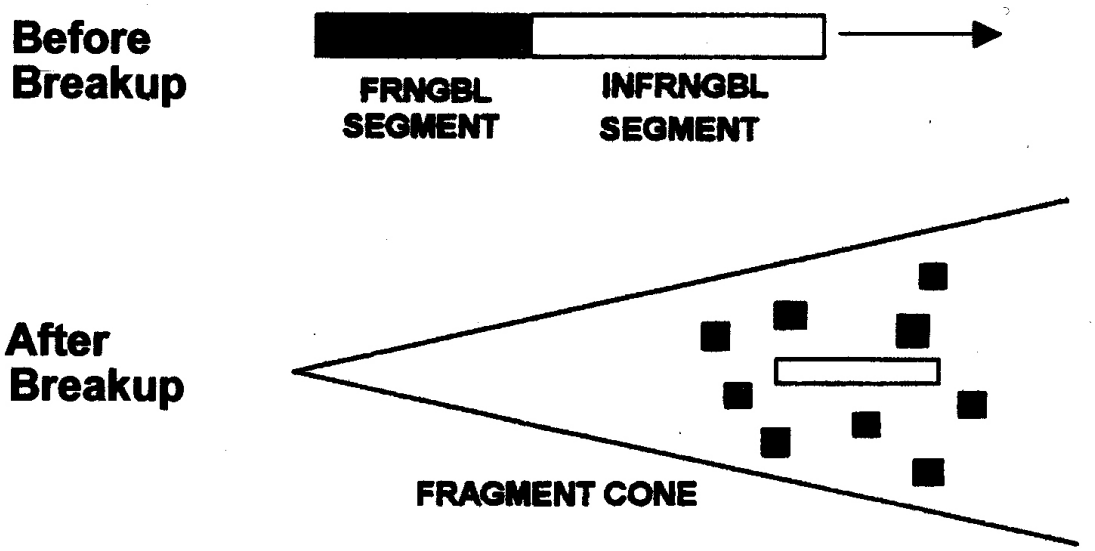
Behind Armor Debris (Final Design)

Weapons and Materials Research



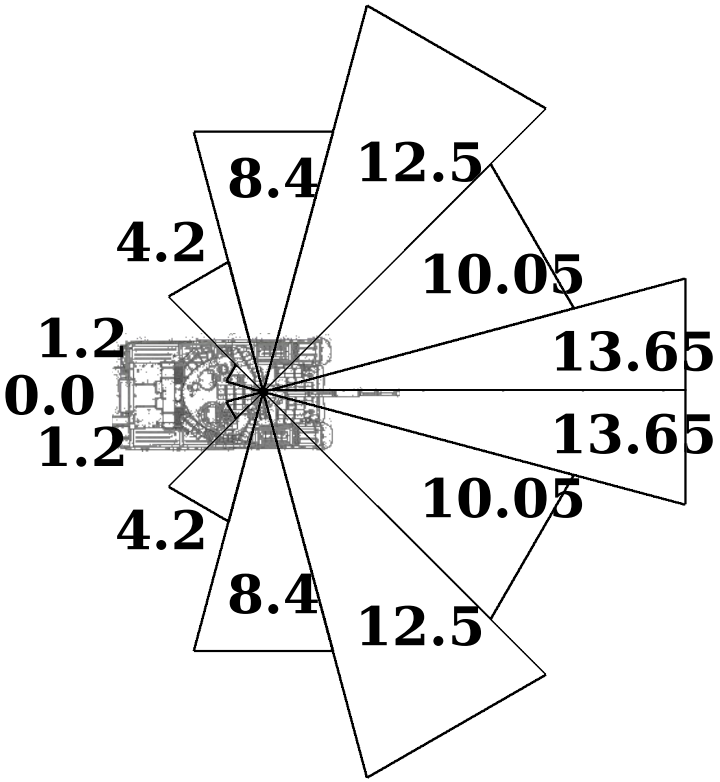
Implementation of Increased Penetrator Fragments

If Residual Velocity is between 250 – 800 m/s then Fragments are Effective

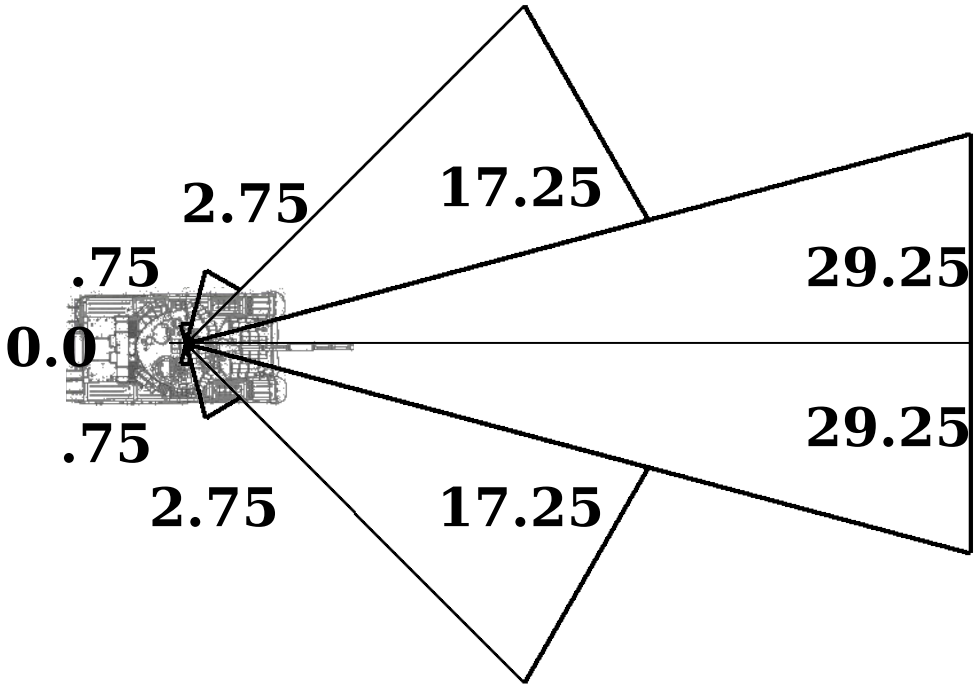


System Engagement Weighting Averages

SURVIVABILITY/LETHALITY ANALYSIS DIRECTORATE



CARDIOID



FRONTAL

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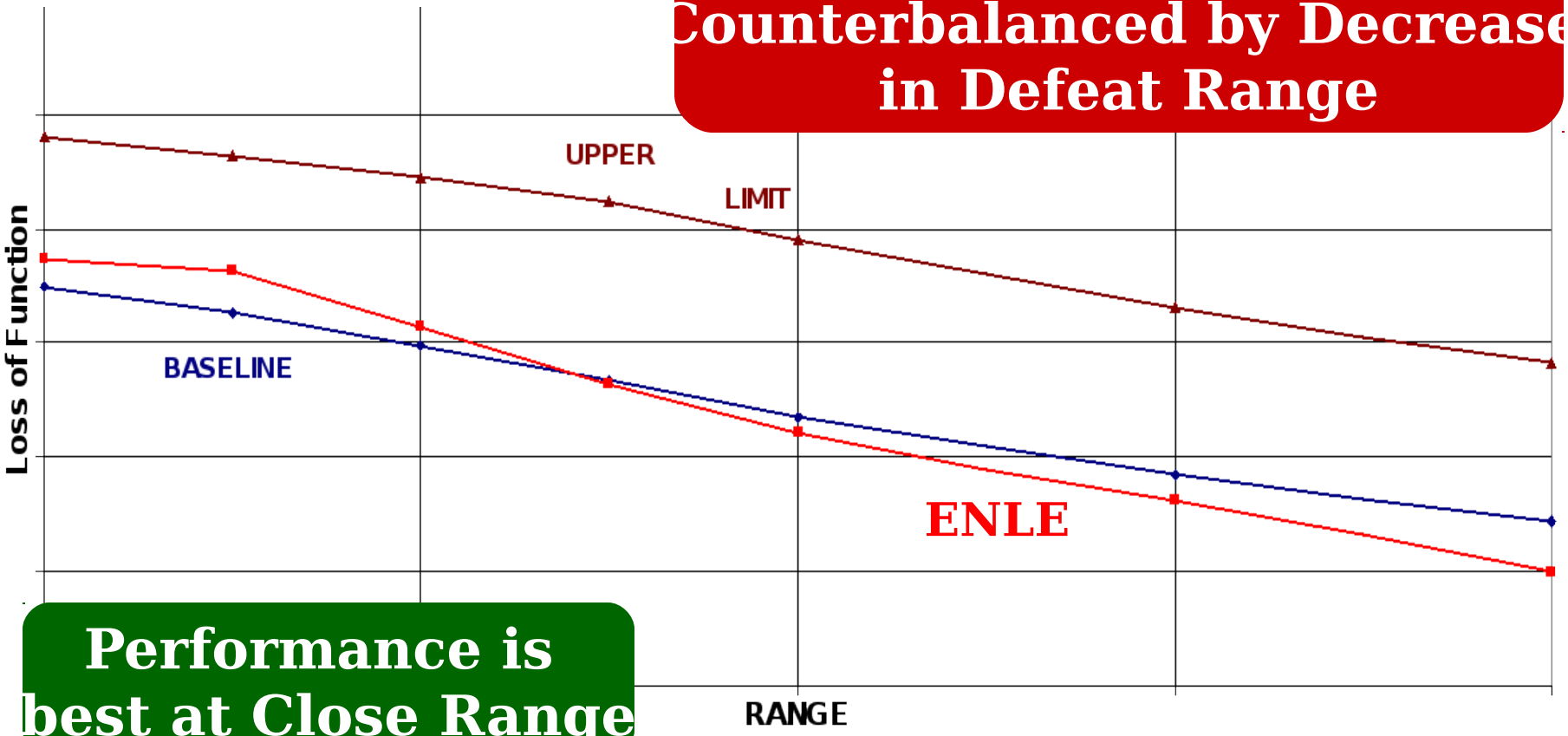
Final Results
(Cardioid Average)

SURVIVABILITY/LETHALITY ANALYSIS DIRECTORATE

crease in Behind Armor Effec
Counterbalanced by Decrease
in Defeat Range



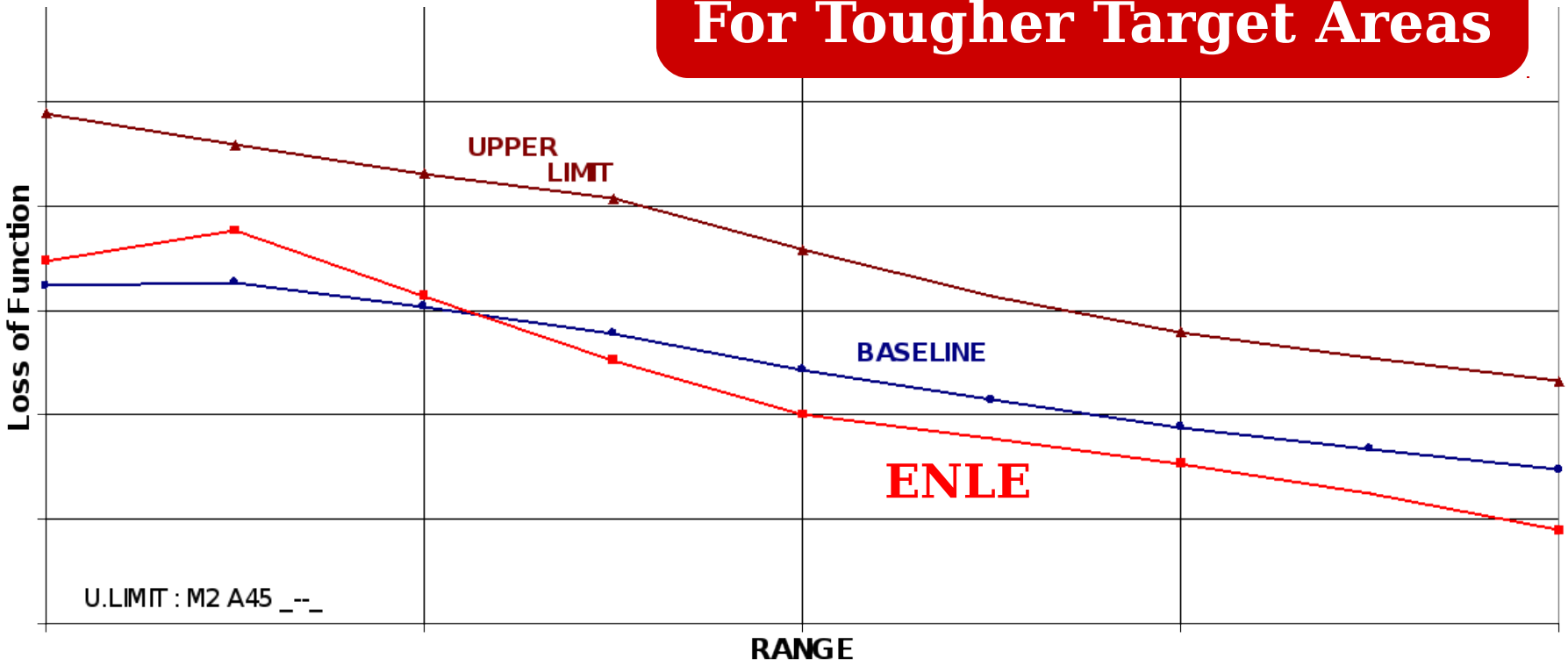
Performance is best at Close Range

A.O. 1/29/04

Final Results
(Frontal Attack)

SURVIVABILITY/LETHALITY ANALYSIS DIRECTORATE

Effects Exaggerated For Tougher Target Areas



Conclusions

1. Completed Experimental Evaluation
    1. >205 shots fired – perforation & BAD
    2. >175 shots BAD – examine witness packs

2. Modified Lethality Model is a very useful tool
    1. Range Target
    2. Modified Description

3. ALACV Advanced KE Improvement
    Highly Dependent on Overmatch
    1. Target
    2. Range